

ASSESSMENT OF MEDICAL STAFF'S KNOWLEDGE CONCERNING THE "FIVE MOMENTS FOR HAND HYGIENE"

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A. Study design/planning • B. Data collection/entry • C. Data analysis/statistics • D. Data interpretation • E. Preparation of manuscript • F. Literature analysis/search • G. Funds collection

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ABSTRACT

Introduction: The guidelines issued by the WHO in 2009 on hand hygiene in healthcare have provided medical professionals with scientific evidence to justify the need to comply with hand hygiene practices when treating patients.

Aim of the study: The aim was to examine the doctors' and nurses' knowledge of the "five moments for hand hygiene" by the WHO.

Material and methods: The study was carried out using a questionnaire devised by the authors of the study; random sampling was used. The study involved 231 doctors and nurses working in a multi-profile hospital in Lesser Poland in 2017.

Results: 75.9% of respondents admitted knowing the "five moments for hand hygiene", 12.9% said they did not know them, and 10.8% abstained. Most often, respondents listed the first point (before patient contact – 81.7%), followed by, respectively: after patient contact – 79.1%; after body fluid exposure risk – 59.2%; before aseptic task – 58.1%; and after contact with patient surroundings – 51.8%. Better knowledge of the "five moments for hand hygiene" was shown by women than by men, by nurses than by doctors, and by people with seniority of less than 20 years. Employees of medical treatment wards presented more knowledge in this regard than employees of surgical departments and ICUs, while the staff of the Emergency Room had the lowest knowledge.

Conclusions: Some respondents did not know the guidelines concerning the "five moments for hand hygiene" by the WHO, and the level of knowledge of those who declared good knowledge of the subject was insufficient.

Key words: hand hygiene, five moments for hand hygiene, nurses, doctors, patient safety.

INTRODUCTION

Hand hygiene (HH) should be maintained by all employees involved in the process of diagnosis and treatment of patients, including doctors and nurses in five situations (moments) indicated by the World Health Organisation (WHO), which came to be called "five moments for hand hygiene". These situations include: 1) "before touching a patient", 2) "before clean/aseptic procedures", 3) "after body fluid exposure/risk", 4) "after touching a patient", and 5) "after touching patient surroundings" [1]. For medical workers, it is vital to be able to recognise these situations [2]. Numerous WHO campaigns for hand hygiene have proven the validity of these recommendations. However, doctors and nurses face numerous difficulties in applying these principles. Compliance with the guidelines is estimated at around 40% of the optimal value [1,3,4]. The results of research conducted in Poland show unsatisfac-

tory compliance with the recommendations of the "five moments for hand hygiene" [5-11].

It is difficult to state unequivocally what causes problems with compliance with hand hygiene guidelines in Poland, although attempts have been made to explain this phenomenon. In the study by Kawalec *et al.* [5] 90% of medical students cited limited access to disinfectants as the reason for the lack of compliance. In the study by Różańska *et al.* [6] the apprenticeship period of 23% of medical students was not preceded by any hospital hygiene training, and in 28% of cases the training did not include HH. Research conducted in Poland has revealed management's poor performance in employee supervision, fear of admonishing other employees, excessive importance assigned to use of gloves in the prevention of infections, and the wearing of long and painted nails by medical staff [10-13].

In addition, multi-centre studies concerning the spread of multi-resistant microorganisms in Polish

hospitals show that infection prevention procedures are not properly applied in practice [14]. Also, the analysis of publications dedicated to the problem of hospital infections in Poland in intensive care units – which are considered key in the emergence of hospital infections – indicates that the current state of infection control is not optimal and the incidence rates for HAI are far from satisfactory [15-18].

AIM OF THE STUDY

The aim of the study was to examine the doctors' and nurses' knowledge of the "five moments for hand hygiene".

MATERIAL AND METHODS

The study was conducted in June 2017 in a multi-profile hospital in the Lesser Poland Voivodeship. A committee and an infection control team are active in the hospital. There are systematic trainings in HH (at least twice a year). The infection control team conducts systematic HH inspections of medical personnel based on the WHO guidelines. The diagnostic survey was randomised. A standardised tool intended for random sampling in the form of a random number table was applied to draw the study group [19]. 150 doctors and 150 nurses were drawn from the list of hospital employees (57 doctors and 22 nurses were excluded from the study due to refusals or other obstacles preventing their participation). In total, 231 doctors and nurses (including 93 [40.3%] doctors and 138 [59.7%] nurses) participated in the study. There were 36 women and 57 men in the group of doctors. There were 135 women and two men in the group of nurses. Variables, such as: gender, age, seniority, occupation, workplace, and ability to list the "five moments for hand hygiene" (in an open-ended question) were analysed.

The study was anonymous. The respondents were asked the following questions:

1. Do you know the "five moments for hand hygiene" by the WHO? (closed question with the option of a "yes" or "no" answer).
2. List the "five moments for hand hygiene" by the WHO (open question).
3. Have you ever felt any discomfort after disinfecting your hands? (closed question with the option of a "yes" or "no" answer).
4. Name the type of discomfort you felt after disinfecting your hands (open question).

The statistical program IBM SPSS (Statistical Package for the Social Sciences – SPSS) STATISTICS 24, Armonk, NY, USA and Microsoft Excel Microsoft Office 2016 Redmond, WA, USA were used to analyse the results. Descriptive methods and methods of statistical inference were used in the statistical analysis of the results obtained. The analysis of variable qualita-

tive features was performed by calculating the number and percentage of occurrences of each value. To characterise the average value for quantitative traits (seniority), the mean and the median (Me) were calculated, and standard deviation (SD) was used as a measure of dispersion. Answers to open questions were analysed according to the analysis principles for multiple answers based on summation and percentage based on observations. The analysis of differences in the tables for multivariate qualitative features was performed using the Pearson chi-square test (χ^2 independence test). The maximum allowable type I error $\alpha = 0.05$ was assumed for all analyses, while $p \leq 0.05$ was considered statistically significant.

The use of data was approved by the Bioethical Committee of the Jagiellonian University (no. KBET/122.6120.124.2016).

RESULTS

Surveys from 231 people were analysed, of whom 173 (74.6%) were women and 58 (25.0%) were men. The average age of doctors was 39 years (SD = 7.45, Me = 40 years). The average age of nurses was 43 years (SD = 9.25, Me = 45 years).

The first question asked was "Do you know the five moments for hand hygiene by the WHO?". In answer to this question, 176 (75.9%) doctors and nurses answered that they did, 30 (12.9%) answered they did not, and 25 (10.8%) abstained from answering. The group of employees who did not know the rules of the "five moments for hand hygiene" mostly comprised men: 20 (34.5%) men and 10 (5.8%) women ($p < 0.001$). In this same group 24 (25.8%) doctors predominated over six (4.3%) nurses ($p < 0.001$). Thus, male medical professionals have less knowledge of the "five moments for hand hygiene", but it should be noted that many more women (12.1%) than men (6.9%) abstained from answering (Table 1).

Respondents were then asked to list the "five moments for hand hygiene". The respondents most frequently mentioned: before touching a patient (81.7%), after touching a patient (79.1%), after body fluid exposure/risk (59.2%), and before clean/aseptic activity (58.1%). The least frequently listed item was "after touching patient surroundings" (51.8%). The answer to this question was given by 190 (82.3%) respondents, while 41 (17.7%) respondents did not list any of the "five moments for hand hygiene", but only 48 (20.1%) of the respondents listed all the "five moments for hand hygiene" (Table 2).

An analysis of variables, such as: gender, seniority, post, and ward was performed in combination with the knowledge of the "five moments for hand hygiene" (Table 3).

Women (W) showed more knowledge than men (M) concerning the five HH items, i.e.: first WHO item

Table 1. Summary of answers to the question: "Do you know the five moments for hand hygiene by the WHO?" taking into account variables such as: gender, seniority, post, and ward; $n = 231$

Variables	I do (Five moments for hand hygiene by WHO)	I don't (Five moments for hand hygiene by WHO)	No answer	Total
	n (%)	n (%)	n (%)	n (%)
Total	176 (75.9)	30 (12.9)	25 (10.8)	231 (100.0)
Gender				
Women	142 (82.1)	10 (5.8)	21 (12.1)	173 (100.0)
Men	34 (58.6)	20 (34.5)	4 (6.9)	58 (100.0)
	$p < 0.001$			
Seniority				
< 20 yrs	74 (75.5)	16 (16.3)	8 (8.2)	98 (100.0)
> 20 yrs	102 (76.6)	14 (10.5)	17 (12.8)	133 (100.0)
	$p < 0.259$			
Post				
Doctor	62 (66.7)	24 (25.8)	7 (7.5)	93 (100.0)
Nurse	114 (82.6)	6 (4.3)	18 (13.0)	138 (100.0)
	$p < 0.001$			
Ward				
Non-surgical ward	40 (83.3)	0 (0.0)	8 (16.7)	48 (100.0)
Surgical ward	97 (75.2)	22 (17.1)	10 (7.8)	129 (100.0)
ICU	33 (78.6)	6 (14.3)	3 (7.1)	42 (100.0)
ER	6 (50.0)	2 (16.7)	4 (33.3)	12 (100.0)
	$p < 0.001$			

World Health Organisation (WHO), Pearson's chi-square (p), ward (O) Intensive Care Unit (ICU), Emergency Room (ER)**Table 2.** Summary of answers to the open question: "List the five moments for hand hygiene by the WHO"; $n = 231$

Five moments for hand hygiene by the WHO	Answers		% of observations
	n	%	
1) Before touching a patient	156	24.8	81.7
2) Before clean/aseptic procedures	111	17.6	58.1
3) After body fluid exposure/risk	113	17.9	59.2
4) After touching a patient	151	24.0	79.1
5) After touching patient surroundings	99	15.7	51.8
Total	630*	100.0	329.8*

Analysis of multiple-choice questions, *percentage and summary based on observations do not add up, 190 (82.3%) of respondents gave an answer, 41 (17.7%) of respondents did not name any of the "five moments for hand hygiene"

– W 81.5% vs. M 81.9%, second WHO item – W 58.3% vs. M 57.5%, third WHO item – W 61.6% vs. M 50.0%, fourth WHO item – W 81.5% vs. M 70.0%, fifth WHO item – W 53.6% vs. M 45.9% (Table 3).

People with lower seniority (below 20 years) listed the "five moments for hand hygiene" correctly more often (except for the second WHO item – before clean/aseptic activity), i.e. first WHO item – ↓ 20 years 87.8% vs. ↑ 20 years 80.0%, second WHO item – ↓ 20 years 53.7% vs. ↑ 20 years 59.3%, third WHO item – ↓ 20 years 65.9% vs. ↑ 20 years 57.3%, fourth WHO item – ↓ 20 years 80.5% vs. ↑ 20 years 87.7%,

fifth WHO item – ↓ 20 years 58.5% vs. ↑ 20 years 50.0% (Table 3).

Nurses (N) possessed greater knowledge of the "five moments for hand hygiene" than doctors (D), i.e.: first WHO item – N 81.9% vs. D 81.3%, second WHO item – N 60.0% vs. D 54.5%, third WHO item – N 68.8% vs. D 40.9%, fourth WHO item – N 81.6% vs. D 74.2%, fifth WHO item – N 59.2% vs. D 37.9% (Table 3).

Employees working in non-surgical (NS) wards were able to list correctly the "five moments for hand hygiene" more often than the employees of the surgery (S) (except for the second WHO item –

Table 3. Summary of answers to the open question: “List the five moments for hand hygiene by the WHO”, considering the gender, seniority, post, and ward variables; $n = 231$

Five moments for hand hygiene by the WHO	Gender		Seniority		Post		Ward			
	Man	Woman	Less than 20 yrs	Over 20 yrs	Doctor	Nurse	Non-surgical ward	Surgical ward	ICU	ER
1) Before touching a patient	81.5%	81.9%	87.8%	80.0%	81.2%	81.9%	92.7%	81.2%	78.9%	54.5%
2) Before clean/aseptic procedures	57.5%	58.3%	53.7%	59.3%	54.5%	60.0%	53.7%	62.4%	52.6%	54.5%
3) After body fluid exposure/risk	50.0%	61.6%	65.9%	57.3%	40.9%	68.8%	80.5%	59.4%	47.4%	18.2%
4) After touching a patient	70.0%	81.5%	80.5%	78.7%	74.2%	81.6%	95.1%	74.3%	84.2%	45.5%
5) After touching patient surroundings	45.0%	53.6%	58.5%	50.0%	37.9%	59.2%	68.3%	46.5%	60.5%	9.1%

Analysis of multiple-choice questions, *percentage and summary based on observations, % do not add up, (O) ward. Intensive Care Unit (ICU), Emergency Room (ER)

before clean/aseptic activity), i.e.: first WHO item – S 92.7% vs. NS 81.2%, second WHO item – S 53.7% vs. NS 62.4%, third WHO item – S 80.5% vs. NS 59.4%, fourth WHO item – S 95.1% vs. NS 74.3%, and fifth WHO item – S 68.3% vs. NS 46.5%. The knowledge of the guidelines was also unsatisfactory among intensive care unit (ICU) employees, i.e.: first WHO item – 78.8%, second WHO item – 52.6%, third WHO item – 47.4%, fourth WHO item – 84.2%, and fifth WHO item – 60.5%. The knowledge among the hospital emergency unit (ER) employees was the lowest, i.e.: first WHO item – 54.5%, second WHO item – 54.5%, third WHO item – 18.2%, fourth WHO item – 45.5%, and fifth WHO item – 9.1% (Table 3).

DISCUSSION

In this study, in answer to the question: “Do you know the five moments for hand hygiene by the WHO?”, as many as 13% replied that they did not know these guidelines, and another 11% abstained from answering. The request to list the “five moments for hand hygiene” by the WHO confirmed the deficit of the employees’ knowledge, because as many as 18% of them did not list any of the “five moments for hand hygiene”, and only 20% listed all five points. Similarly, in a study by Woodard *et al.* [20] only 21% of respondents were able to list all the “five moments for hand hygiene”. The least known moment was hand disinfection “after touching the patient’s surroundings” (51.8%), while in a study by Kawalec *et al.* [5] among medical students, as many as 36% of them did not disinfect their hands “before examining the patient”. Garus-Pakowska *et al.* [7, 8] conducted an observation among a group of 188 medical staff (nurses and doctors). In this study medical staff complied with the HH procedure only in 5% of cases before touching the patient and in 26% of cases after touching the patient. Research conducted by Kołpa *et al.* [9] on a group of

100 randomly selected medical workers (nurses, doctors, and paramedics) showed that only 28% of the respondents knew that the dominant method of keeping hands clean according to the WHO is their disinfection. In the study by Różańska *et al.* [6] conducted among 414 medical students, only 53% of them knew the HH guidelines. In-depth knowledge of the WHO’s “five moments for hand hygiene” among doctors and nurses seems to be a key issue in applying these guidelines in practice and, consequently, to reducing the number of nosocomial infections. However, as research in Poland shows, poor knowledge of these principles can already be traced to medical students who did not internalise these principles prior to their first contact with the patient [6, 10]. In a study by Wałaszek *et al.* [10], in which 100 respondents (medical students, interns, physicians) were examined, it was found that 3/4 of the respondents did not correctly apply HH techniques and that compliance with HH principles was insufficient in all the “five moments for hand hygiene” (the highest score was 74%: before clean/aseptic procedures, and the lowest was 1%: after touching the patient’s surroundings). In a study by Woodard [20], 46% of the respondents judged the moment “before clean/aseptic procedure” as the most important of them all, and 86% identified “after touching the patient’s surroundings” as the least important. In another study by Wałaszek *et al.* [11], 173 patients and 286 nurses were examined; it was found that only 75% of patients and 54% of nurses confirmed that they saw a medical worker perform HH procedures before puncturing their vein when taking a blood sample. In another study, compliance with HH was shown by only 37% of medical workers who had disinfected their hands before touching the patient, 9% before clean/aseptic procedures, 5% after body fluid exposure/risk, 63% after touching the patient, and 35% after touching the patient surroundings [19]. Moreover, postgraduate medical education in Poland is largely ineffective in promoting

knowledge about hand hygiene in the medical field [12]. National culture itself and the related low levels of hand hygiene habits in society are not conducive to promoting these principles in the family and school and giving them high status also in pre- and post-graduate education [11].

In our research, more women than men were familiar with the "five moments for hand hygiene". This is also confirmed by the WHO publication [1] in which the "male" variable was qualified as a factor conditioning improper hand hygiene. In the cross-sectional study by Suen [21] on gender inequality and hand hygiene among 815 respondents, it was found that female respondents had much better knowledge of HH than men. In this study, being a middle-aged woman and having a university degree was a factor in increasing knowledge about HH [21]. Similarly, in a study by Wałaszek [12], the average age of the respondents and higher education were associated with greater knowledge of hand hygiene. A study by Birnbach [22] carried out an observation of 150 medical students (third and fourth year of study) who, after undergoing HH training, completed internships in the intensive care unit; in this study 75% of men and 25% of women did not perform HH in the required situations. This study showed that even if medical students received intensive HH education, compliance remained low [22]. In this study, men and women presented various reasons why they did not comply with HH: men pointed to setbacks in performing HH, i.e. lack of time, lack of role models, and unclear requirements, while women pointed to dry or cracked skin and forgetfulness [22].

Similarly, nurses in our study had more knowledge of the "five moments for hand hygiene". In a study by Bowley *et al.* [23] a program was developed that focused on compliance with hand hygiene before and after touching the patient. After intensive education, compliance with HH increased to 69%, and it was noted that the nurse's compliance with HH (77%) was significantly higher than that of doctors (38%); $p < 0.0001$. A study by Laskar *et al.* [24] examining intensive care units showed that the highest compliance with HH guidelines was among nurses, where after an intervention (audit, direct observations, knowledge tests – which were carried out for one month), the compliance with HH guidelines was increased from 3.6% in the pre-intervention phase to 81% after intervention. Based on the review of the literature, it can be seen that nurses have a deep-rooted autotelic attitude towards the patient, which causes them to care deeply for the good of the patient, and in this case for the prevention of hospital infections, which they express through hand hygiene [25, 26]. Zawadzka [27], describing the experience of implementing a hand hygiene program, emphasises the greater participation of nurses than doctors in the training concerning hand hygiene, which may translate into the doctors' lower

compliance in practice. As noted by Ciuruś [28], medical staff are employed on various forms of a contract that may not contain a clause on the need to participate in the trainings, and the need to perform their duties often prevents them from leaving the workplace, which may hinder effective transfer of knowledge in the field of hand hygiene [28].

Unfortunately, the presented results indicate that the lowest knowledge of HH guidelines was found among the employees of the hospital emergency room; their knowledge of the particular WHO moments was as follows: 1) 55%, 2) 55%, 3) 18%, 4) 45%, and 5) 9%. In a Danish study conducted in 2019, emergency room employees self-assessed their HH compliance with requirements at $\geq 80\%$; they concluded that the accessibility to the means for HH at the care facility had a significant impact on compliance, as well as being shown a good example and following simple instructions similar to the HH guidelines [29]. In a study by Wałaszek *et al.* [10] medical students undergoing internships in various hospitals were interviewed, and as a result the existence of numerous hand hygiene difficulties was highlighted; respondents pointed to difficulties in accessing soap, towels, and disinfectants. Unfortunately, students also showed a sceptical approach to hand hygiene, arguing that the use of gloves is sufficient, and pointed to the lack of a "good example" being set among medical staff.

In our study, the knowledge of HH among intensive care unit (ICU) employees was also unsatisfactory, as in the study by Laskar *et al.* [24] where it was found that only 55% to 82% of medical staff were aware of the existence of the "five moments for hand hygiene" published by the WHO. An interesting observational study was conducted by Stahmeyer *et al.* [30] in two intensive care units to determine the average number of HH procedures per patient, and the overall compliance with the five WHO moments for HH was 43%. The author showed that compliance with HH guidelines in ICU wards is time consuming (hand disinfection time was 7.6 seconds, a total of 6.9 minutes daily for internal ICU and 8.3 minutes for surgical ICU), which amounts to 58.2 minutes (internal ICU) and 69.8 minutes (surgical ICU) spent daily only on HH. Therefore, the time needed for HH should be included in the planning of the ICU staffing [30].

Why does the compliance with hand hygiene remain unsatisfactory? In our study, when asked about the discomfort felt when using hand disinfectants, 42% of respondents confirmed that they had had such an experience; they reported mostly: a feeling of dry hands 28%, cracking of the epidermis 26%, and burning and itching of the skin 24%. Birnbach *et al.* [22] obtained similar results in a study in which 34% of women respondents indicated dry or cracked skin. In the same study, broader responses to obstacles in the way of HH were obtained, including: no time 21%, no role mod-

els 11%, ambiguity of requirements 59%, and forgetfulness 24% [22]. In a Polish study by Wałaszek *et al.* [10] the existence of numerous other difficulties in hand hygiene was found, such as difficulties in access to soap, towels, and disinfectants, and poor quality of disinfectants that caused irritation of the skin of the hands. Researchers believe that the drying of the hands is not a direct result of the use of alcohol-based preparations, but that the reason may be excessive hand washing [31]. Therefore, in the education of medical staff, the guidelines of hand disinfection should be emphasised, which indicate that both of these techniques should not be combined (choose either a disinfection procedure or simply soap and water). The WHO emphasises that washing your hands with soap and water does not require the use of a disinfection agent [1].

In searching for sources of ineffectiveness of education in the field of hand hygiene in Poland, individual and institutional factors should be considered. Among individual factors, it may be helpful to focus on the professional by showing and strengthening the benefits of using hand hygiene guidelines for both the professional and the patient, and supporting the professional by demonstrating an understanding of the difficulties encountered in implementing these principles. It is advisable also to build positive attitudes towards HH prophylactic effects and strengthen the sense of self-efficacy by providing skills for effective hand hygiene and recognising the situation in which it is to be applied. Awareness of the features of national culture that have been studied and described by Hofstede *et al.* [32] may be helpful in implementing this approach. These studies revealed that Poland is a country in which people are characterised by strong individuality, which can create problems in interpersonal communication, between professional groups and in staff-patient contacts. According to this knowledge, actions aimed at improving hand hygiene should be carried out through personal contact with doctors, nurses, and other medical staff in order to emphasise their influence, significance, rank, and respect for their views and attitudes.

The institutional factors affecting compliance with HH principles include the relative novelty of the infection surveillance system in Poland and the consequences of post-transformation changes in the form of erosion of ethical standards, which also affected healthcare professionals in the form of low trust levels towards them. One of the elements of erosion of ethical standards is considerable tolerance towards unethical behaviour [33]. These behaviours also include the failure to perform HH procedures in situations defined by the WHO. In a sense, one can speak of dualism in this area – on the one hand, medical staff largely ignore patient safety (non-compliance with hand hygiene); on the other hand, it is ignored by the system itself (low salaries, excessive workload, equipment deficits). As Dylus [33] writes, the erosion process occurs even fast-

er if more people who are high in the hierarchy take unethical actions. Progressive disruptions in this area lead to paralysis of creative initiatives and inhibition of progress. In the case of implementing a hand hygiene improvement program, partnership cooperation between all professional groups is necessary [34]. In implementing this approach, account should be taken of the features described by Hofstede *et al.* [32] regarding the tendency of avoiding uncertainty. In Poland, this tendency is particularly strong and is correlated with low trust. A high level of avoiding uncertainty (distrust) can lead to delays and difficulties in implementing HH programs as a result of defensive attitudes of the employees. Internal training for employees should be supplemented with training conducted by external experts (expert knowledge reduces the feeling of uncertainty and increases the level of trust).

There is a concern that in Poland, due to this type of culture and the high power distance in hospitals, excessive workload of medical staff, staff shortage, constant underinvestment, low trust, and erosion of moral standards, the implementation of WHO recommendations may be extremely difficult. Unfortunately, it should be concluded that achieving changes in this field may indeed be demanding and that the planning of system changes should involve knowledge in the field of pedagogy, psychology, sociology, organisation, and management. This study may be used to better understand the mechanisms of compliance with and implementation of the recommendations of the WHO in Poland.

However, due to the chronic shortage of doctors and nurses in Poland, most of them work in many different healthcare facilities, in which it is necessary to follow the same procedures and in which they undergo similar education in the field of hand hygiene. The OECD report [35] shows a significantly smaller number of nurses in Poland: 3.4 nurses per 1000 inhabitants (average OCDE 9.0), and a significantly smaller number of doctors: 2.3 doctors per 1000 inhabitants (OECD average 3.5). The shortage of staff and low wages mean that most doctors and nurses take up additional work in various healthcare facilities. Therefore, it seems that due to these circumstances, an attempt can be made to generalise the results obtained in this study to the situation in other healthcare institutions in Poland.

CONCLUSIONS

Knowledge of the “five moments for hand hygiene” among the respondents was insufficient.

Medical workers’ education concerning hand hygiene at the pre-diploma and post-diploma levels is insufficient.

It is vital to carry out further research and take steps in order to increase the effectiveness of hand hygiene in medical practice.

Disclosure

The authors declare no conflict of interest.

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